zone near said substrate side, the ratio of percentage content of solvent-catalyst metal to diamond is greater than it is at a second point in said gradient transition zone closer to said diamond side than said first point,

chemical bonds between said diamond table and said substrate which tend to secure said diamond table to said substrate, and

a sintered polycrystalline diamond load bearing and articulation surface on said polycrystalline diamond compact, said sintered polycrystalline diamond load bearing and articulation surface including polycrystalline diamond, said sintered polycrystalline diamond load bearing and articulation surface being formed to present a shape that is at least partially convex spherical;

wherein diamond in said sintered polycrystalline diamond compact has a coefficient of thermal expansion CTE_{Cd}, and wherein said substrate has a coefficient of thermal expansion CTE_{sub}, and wherein CTE_{Cd} is not equal to CTE_{sub}, wherein said diamond in said polycrystalline diamond compact has a modulus $M_{Cd,}$ and wherein said substrate in said polycrystalline diamond compact has a modulus M_{sub}, and wherein $M_{Cd,}$ is not equal to M_{sub}.

81. A head as recited in claim 80 further comprising a mechanical grip between said diamond table and said substrate, said mechanical grip tending to secure said diamond table to said substrate.

82. A head as recited in claim 80 further comprising interstitial spaces in said diamond table.

83. A head as recited in claim 82 further comprising solvent-catalyst metal located in said diamond table interstitial spaces.

84. A head as recited in claim 80 further comprising a residual stress field in said polycrystalline diamond compact that tends to enhance the strength of said polycrystalline diamond compact.

85. A head as recited in claim 80 further comprising a crystalline diamond structure in said diamond table.

86. A head as recited in claim 80 wherein said polycrystalline diamond compact is polished to an Ra value of between about 0.5 to about 0.005 microns.

87. A head as recited in claim 80 wherein said substrate includes a plurality of metals.

88. A head as recited in claim 80 wherein said substrate includes a metal alloy selected from the group consisting of titanium, titanium aluminum and vanadium,

titanium molybdenum hafnium, titanium and nitinol, cobalt chrome, cobalt chrome molybdenum, cobalt chrome tungsten, cobalt chrome cemented tungsten carbide, cobalt chrome cemented chrome carbide, fused silicon carbide and stainless steel.

89. A head as recited in claim 80 further comprising a first substrate layer and a second substrate layer.

90. A head as recited in claim 89 wherein said first substrate layer includes at least one metal not found in said second substrate layer.

91. A head as recited in claim 89 further comprising a barrier layer between said first and second substrate layers.

92. A head as recited in claim 80 wherein in said polycrystalline diamond compact diamond table, at least two different sizes of diamond crystals are found.

93. A head as recited in claim 80 further comprising substrate surface topographical features on said substrate.

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94. A head as recited in claim 80 wherein said sintered polycrystalline diamond load bearing and articulation surface has an Ra value of between about 0.5 to about 0.005 microns.

95. A head as recited in claim 80 wherein said sintered polycrystalline diamond load bearing and articulation surface is burnished.

96. A femoral head comprising:

a metal substrate,

a diamond table,

said substrate and said diamond table forming a sintered polycrystalline diamond compact,

a zone between said substrate and said diamond table that has a composition gradient of decreasing solvent-catalyst metal content across said zone,

chemical bonds in said zone, said chemical bonds including diamond-to-diamond bonds in said diamond table, diamond-to-metal bonds in said gradient transition zone, and metal-to-metal bonds in said solvent-catalyst metal,

at least some of said bonds being sp3 carbon bonds,

a mechanical grip between said diamond table and said substrate which tends to secure said diamond table to said substrate,

said mechanical grip being achieved at least in part by residual stresses between said substrate and said diamond table,

interstitial spaces in said diamond table,

solvent-catalyst metal present in said interstitial spaces, and

a non-planar sintered polycrystalline diamond load bearing and articulation surface formed by said diamond table,

said non-planar sintered polycrystalline diamond load bearing and articulation surface serving to permit articulation of the femoral head in a human body.

97 ~~98.~~ A femoral head as recited in claim ~~97~~ 96 wherein sintered diamond in said diamond table has a coefficient of thermal expansion CTE_{Cd}, and wherein said substrate has a coefficient of thermal expansion CTE_{sub}, and wherein CTE_{Cd} is not equal to CTE_{sub}.

98 ~~99.~~ A femoral head as recited in claim ~~97~~ 96 wherein said sintered diamond in said diamond table has a modulus $M_{Cd,}$ and wherein said substrate has a modulus M_{sub}, and wherein $M_{Cd,}$ is not equal to M_{sub}.

99 ~~100.~~ A femoral head as recited in claim ~~97~~ 96 further comprising a residual stress field that tends to enhance the strength of attachment of said diamond table to said substrate.

100 ~~101.~~ A femoral head as recited in claim ~~97~~ 96 further comprising substrate surface topographical features on said substrate.

B1 Cont 101 ~~102.~~ A femoral head as recited in claim ~~97~~ 96 wherein said substrate includes a metal alloy with at least one femoral head of said metal alloy being selected from the group consisting of titanium, aluminum, vanadium, molybdenum, hafnium, nitinol, cobalt, chrome, molybdenum, tungsten, cemented tungsten carbide, cemented chrome carbide, fused silicon carbide, nickel, tantalum, and stainless steel.

102 ~~103.~~ A femoral head as recited in claim ~~97~~ 96 wherein diamond table comprises diamond feedstock that has diamond particles that have a dimension in the range of less than about 1 nanometer to more than about 100 microns.

103 ~~104.~~ A femoral head as recited in claim ~~97~~ 96 wherein said sintered polycrystalline diamond load bearing and articulation surfaces is a continuous diamond surface.

104 ~~105.~~ A femoral head as recited in claim ~~97~~ 96 wherein said sintered polycrystalline diamond load bearing and articulation surface is a discontinuous diamond surface.

105 ~~106.~~ A femoral head as recited in claim ~~97~~ 96 wherein said sintered polycrystalline diamond load bearing and articulation surface is a segmented diamond surface.

106 ~~107.~~ A femoral head as recited in claim ~~97~~ 96 wherein a lip is present on said substrate in order to mechanically interlock said diamond table to said substrate.

107 ~~109.~~ A femoral head as recited in claim ~~97~~ 96 further comprising CoCr solvent-catalyst metal in said diamond table interstitial spaces.

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108 ~~110~~. A femoral head as recited in claim ~~97~~ further comprising a continuous gradient in said diamond table.

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109 ~~111~~. A femoral head as recited in claim ~~97~~ further comprising an incremental gradient in said diamond table.

110 ~~112~~. A femoral head as recited in claim 64 wherein said incremental gradient includes a plurality of strata in said diamond table, a first of said strata having characteristics which differ from those of a second strata.

111 ~~113~~. A femoral head as recited in claim 65 wherein said differing characteristics of said strata are selected from the group consisting of diamond particle size, diamond particle distribution, and solvent-catalyst metal content.

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112 ~~114~~. A femoral head as recited in claim ~~97~~ further comprising an interface gradient.

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113 ~~115~~. A femoral head as recited in claim ~~97~~ wherein said diamond table has a thickness of from less than about 1 micron to more than about 3000 microns.

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114 ~~116~~. A femoral head comprising:

a substrate,

a diamond table sintered to said substrate,

said substrate and diamond table forming a sintered polycrystalline diamond compact,

a zone that includes both sintered diamond and substrate, said zone having a composition gradient of solvent-catalyst metal content to diamond content, said gradient being selected from the group consisting of interface gradient, continuous gradient and incremental gradient,

chemical bonds in the femoral head, said chemical bonds including diamond-to-diamond bonds in said diamond table, diamond-to-metal bonds in said zone, and metal-to-metal bonds in said solvent-catalyst metal,

a mechanical grip between said diamond table and said substrate which tends to secure said diamond table to said substrate, and

a non-planar load bearing and articulation surface formed by said diamond table.

114

115 ~~117~~. A femoral head as recited in claim ~~116~~ wherein at least some of said bonds are sp3 carbon bonds.

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116 ~~118~~. A femoral head as recited in claim ~~116~~ wherein said diamond table includes a plurality of strata such that a first of said strata having characteristics which differ from those of a second strata.

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117 ~~119~~. A femoral head as recited in claim ~~118~~ wherein said differing characteristics are selected from the group consisting of diamond particle size, diamond particle distribution, and solvent-catalyst metal content.

119 ~~120~~. A femoral head as recited in claim ~~116~~ 114 wherein said diamond table has been formed using CoCr as a solvent-catalyst metal.

119 ~~121~~. A femoral head as recited in claim ~~116~~ 114 wherein said diamond table presents a non-planar sintered polycrystalline diamond load bearing and articulation surface.

120 ~~122~~. A femoral head as recited in claim further interstitial spaces located in said diamond table, and solvent-catalyst metal located in said interstitial spaces.

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121 ~~123~~. A femoral head as recited in claim ~~116~~ 111 further comprising interstitial spaces in said diamond table; wherein said interstitial spaces are at least partially filled with a metal.

122 ~~124~~. A femoral head as recited in claim ~~123~~ 121 wherein said interstitial spaces are filled with solvent-catalyst metal.

Remarks

Applicant incorporates by reference here the remarks from the previous response to office action as those remarks highlight differences between Applicant's claim elements and the cited prior art.

In particular, Applicant wishes to point out that Beuchel is does not contain sufficient disclosure concerning how to make a diamond-surfaced femoral head to enable a person of ordinary skill in the art to make one. Therefore Beuchel is not enabling and cannot be considered a prior art reference under section 102. Applicant requests withdrawal of Beuchel as a prior art reference.

1. **Claim for Priority**. Applicant has attached hereto a new Declaration of Inventors and a new first page of the patent application asserting a claim for priority through a series of patent applications dating back to August 12, 1994. Applicant requests that the claim for priority be entered in the case. As this case was filed before the new rules governing a claim for priority, Applicant believes that this claim should be treated under the old rules.

2. **Formal Drawings**. Formal drawings are submitted herewith.

3. **Terminal Disclaimer**. The Examiner imposed an obviousness rejection under the judicially-created doctrine of obviousness type double patenting. Applicant has included a terminal disclaimer and fee to overcome that rejection.

4. **35 USC 102**. Applicant has submitted new to more clearly distinguish the invention from the cited prior art. The pending claims recite elements and limitations not found in the prior art references. Pope '601 is not longer a prior art reference in view of